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Routing in Dynamic Mobile Adhoc Networks

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***Abstract:** In a Mobile Ad hoc Network (MANET), mobile nodes move around arbitrarily, nodes may join and leave at any time, and the resulting topology is constantly changing. Routing in a MANET is challenging because of the dynamic topology and the lack of an existing fixed infrastructure. The Dynamic MANET On-demand (DYMO) protocol builds on existing Adhoc On-Demand Distance Vector (AODV) routing protocol, evaluated in the context of sensor networks proposed for MANETs. AODV work only when a data is delivered to them so as to maintain the route to the destination (reactive routing protocol). DYMO can work both as proactive and reactive protocol as the routes can be discovered when they are needed. The DYMO protocol is currently under development by the Internet Engineering Task Force (IETF). The main objective of this thesis lies in implementing the DYMO protocol as a successor to AODV. The implementation was made in ns version 2, a programming language and Simulation scripts are written in the OTcl language, an extension of the Tcl scripting language. A simplified version of the DYMO protocol has been implemented with a more compact packet format adapted to bandwidth and delay constraints. The evaluation consists of experiments performed to determine the applicability of the DYMO protocol for a typical sensor network application. In this paper the results are produced using ns2 simulator.*

***Keywords:** Manet, multi-hop routing, link layer adhoc networks, sensor networks.*

I. INTRODUCTION

In Latin, adhoc means "for this," further meaning "for this purpose only". It is a good and emblematic description of the idea why adhoc networks are needed. They can be set up anywhere without any need for external infrastructure (like wires or base stations). They are often mobile and that's why a term MANET is often used when talking about Mobile Adhoc Networks.

MANETs are often defined as follows: A "mobile adhoc network" (MANET) is an autonomous system of mobile routers (and associated hosts) connected by wireless links - the union of which forms an arbitrary graph. The routers are free to move randomly and organize themselves arbitrarily; thus, the network's wireless topology may change rapidly and unpredictably [1]. Such a network may operate in a standalone fashion, or may be connected to the larger Internet. An adhoc network is a LAN or other small network, especially one with wireless connections, in which some of the network devices are part of the network only for the duration of a communications session or, in the case of mobile or portable devices, while in some close proximity to the rest of the network. The adhoc network is a communication network without a pre-exist network infrastructure. In cellular networks, there is a network infrastructure represented by the base-stations, Radio network controllers, etc.

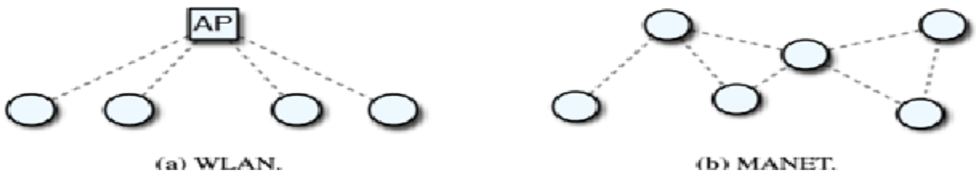

Fig 1: (a) Nodes in a WLAN managed by an access point (b) Nodes in MANET independently forming a routing infrastructure

Mobile Adhoc Network (MANET) is a collection of independent mobile nodes that can communicate to each other via radio waves [4]. The mobile nodes that are in radio range of each other can directly communicate, whereas others need the aid of intermediate nodes to route their packets. These networks are fully distributed, and can work at any place without the help of any infrastructure. This property makes these networks highly exile and robust. Generally, the communication terminals have a mobility nature which makes the topology of the distributed networks time varying [2]. The dynamical nature of the network topology increases the challenges of the design of adhoc networks. Each radio terminal is usually powered by energy limited power source (as rechargeable batteries). The power consumption of each radio terminal could be divided generally into three parts, power consumption for data processing inside the RT, power consumption to transmit its own information to the destination, and finally the power consumption when the RT is used as a router, i.e. forwarding the information to another RT in the network. The energy consumption is a critical issue in the design of the adhoc networks. The mobile devices usually have limited storage and low computational capabilities. They heavily depend on other hosts and resources for data access and information processing. A reliable network topology must be assured through efficient and secure routing protocols for adhoc networks.

The origins of MANETs are to be found in the US military and one envisioned use is military. For example, in the battlefield, different units could be able to communicate even if an existing infrastructure has been destroyed or is untrusted. Second, MANETs could be used in rescue and disaster relief efforts, for instance in remote areas with little or insufficient communication possibilities. A third application area is in sensor networks. A network of autonomously cooperating sensors can perform tasks not previously possible in traditional networks. Typically, nodes are relatively small units placed in an environment to monitor some kind of phenomenon. An example could be vehicle-to-vehicle communication. A sensor placed on a vehicle could detect road conditions and propagate this information to other vehicles on the road. A fourth area is temporary networks, for example deployed at conferences, meeting rooms, and airports. Wireless Internet connection at airports can be expensive, and a group of people could share a connection with the use of a MANET. Finally a fifth application area could be a wireless personal area network with watches, laptops, PDAs, cell phones, and wearable computing devices sharing and exchanging information and delivering added convenience for the owner. Some of the motivation of the different application areas can be summarized as either total lack of an infrastructure, unwillingness to use any existing infrastructure, or the desire to extend coverage of an existing infrastructure. Adhoc networks can provide communication for civilian applications, such as disaster recovery and message exchanges among medical and security personnel involved in rescue missions.

II. Literature Review

DYMO routing protocol is a successor to the popular Adhoc On-Demand Distance Vector Routing Protocol (AODV). AODV is a packet routing protocol designed for use in mobile adhoc networks (MANET).The route discovery mechanism is invoked only if a route to a destination is not known. Source, destination and next hop are addressed using IP addressing. Each node maintains a routing table that contains information about reaching destination nodes. Each entry is keyed to a destination node.

The main advantage of this protocol is having routes established on demand. The destination sequence numbers are applied to find the latest route to the destination. One disadvantage of this protocol is that intermediate nodes can lead to inconsistent routes if the source sequence number is very old and the intermediate nodes don't have the latest destination sequence number. This results in having stale entries.

The DYMO routing protocol is a recently proposed protocol currently defined in an IETF (Internet Engineering Task Force) Internet-Draft. The DYMO has currently seen 6 revisions, the fourth being a change in the packet layout. At the time of writing the latest specification is from October 2006 and is still work in progress. Each node in these routing protocols in Mobile Adhoc Networks operates on constrained battery power [2]. The power will start decreases with time even though the node is idle. Power management is an important concept which concentrates how to reduce the energy consumed in the wireless interface of battery-operated mobile devices. So Energy Conservation is taken as a prime factor since all wireless devices usually rely on portable power sources such as batteries to provide the necessary power.

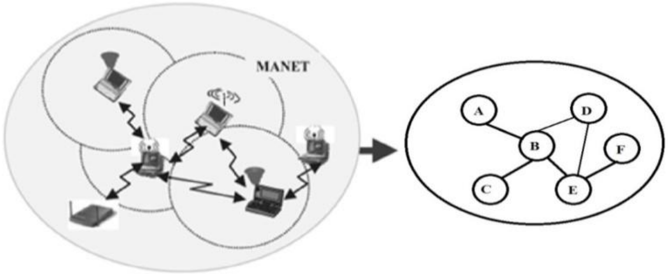

Fig. 2: MANET cell structure

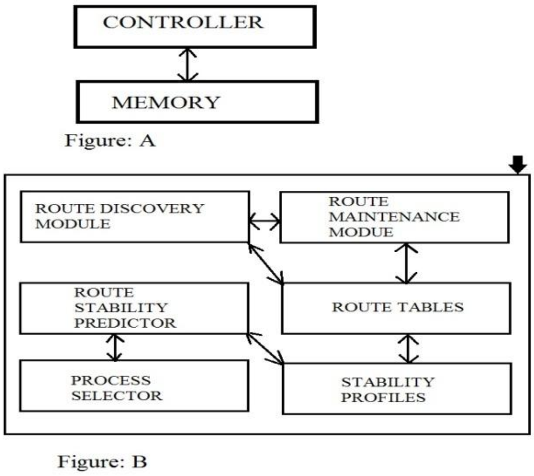

Fig. 3: Figure A: Internal architecture of Wireless Node Figure B: Details of the controller.

III. PROPOSED SYSTEM

DYMO routing protocol is a successor to the popular adhoc on demand distance vector routing protocol (AODV).DYMO shares many of the benefits of AODV and it is slightly easier to implement and designed with future enhancements. DYMO can work as both a pro-active and as a reactive routing protocol, i.e. routes can be discovered just when they are needed. Routing from one node to another uses an on-demand routing protocol, such as DSR or AODV, which generates routing information only when a station initiates a transmission. As a reactive protocol, DYMO does not explicitly store the network topology. Instead, nodes compute a unicast route towards the desired destination only when needed. As a result, little routing information is exchanged, which reduces network traffic overhead and thus saves bandwidth and power. Also, since little routing state is stored, DYMO is applicable to memory constrained nodes. If the routes have not been used for a longtime, they are deleted. If a node is requested to forward a packet through a deleted route, it generates a Route-Error (RERR) message to warn the originating node (and other nodes) that this route is no longer available. As another route maintenance mechanism, DYMO use sequence numbers and hop counts to determine the usefulness and quality of a route. We explain the operation of DYMO in more detail in the following sections.

ROUTE DISCOVERY

The messages are exchanged during the process of route discovery, that is RREQs and RREPs, are called routing messages. They always include the target and originator addresses, as well as a hop limit and a hop count which prevent a routing message from being forwarded several times. Since hop counts are used to determine the quality of a route, a mechanism to ensure loop freedom and avoid the count-to-infinity problem is needed.

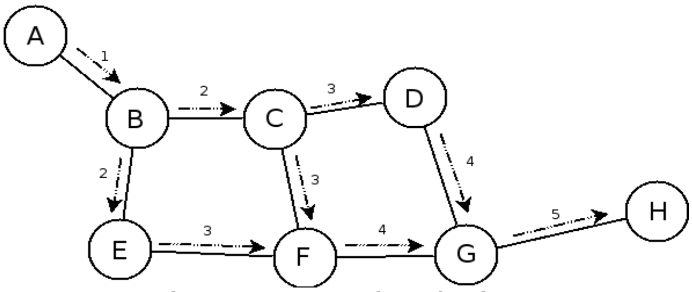

Fig.4 : Node A wants a route to node H, it broadcasts a RREQ.

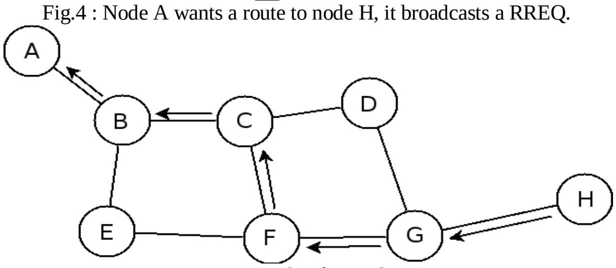

Fig.5 : Packet forwarding.

PACKET PROCESSING AND FORWARDING

Nodes receive a routing message at first and then they look at all the included routing information. Based on sequence numbers and distances counted in hops, they decide whether the routing information is better than what they already know, and update their routing tables consequently.

If a piece of routing information about a node is judged useful, it is assumed that the node can be reached through the sender of the packet (at the link layer), and the routing table is updated accordingly. Therefore, links are assumed to be bidirectional. Also, during this process, the content of the message is updated. Hop counts are incremented and routing information that was not considered useful is removed from the message so that it is not propagated further. After having judiciously updated their routing tables, nodes can append additional routing information to a routing message before forwarding it. They can add information about themselves or about other nodes, whenever they believe it will be useful for surrounding nodes. This may decrease the number of RREQs and enable quicker RREPs. Indeed, when a node receives a RREQ with a target for which it knows a fresh route, it can send an intermediate RREP instead of forwarding the RREQ. As a result, the originator of the RREQ receives the RREP sooner, and the RREQ is not propagated further, which reduces the traffic over-head. Appending routing information to routing messages increases the chances that other nodes will send intermediate RREPs at the expense of bigger packets.

IV. RESULTS

The wireless topography is represented with ‘n’ number of nodes having mobility feature as shown below. Each node configures to the existing network, identify themselves and their neighboring nodes by handshaking or exchanging alert messages.

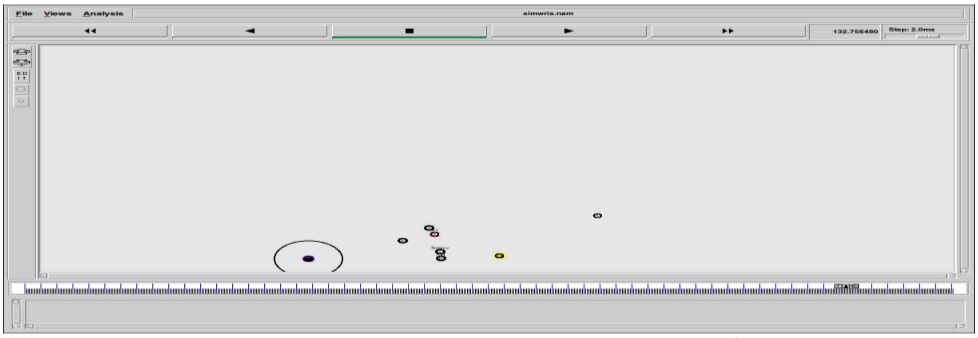
Fig..6 : Wireless Adhoc Topography representing hot spots sharing identifying messages

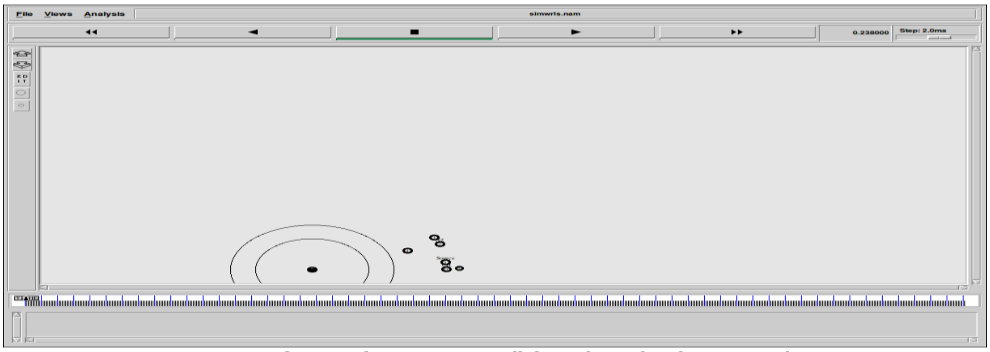
Fig. 7: Broadcasting alert messages to all the nodes within the Topography

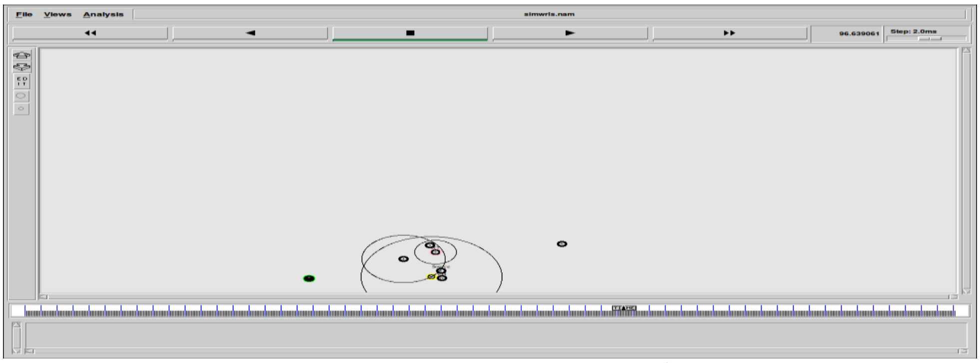
Fig. 8: Alert messages among nodes in Topography identifying neighbours

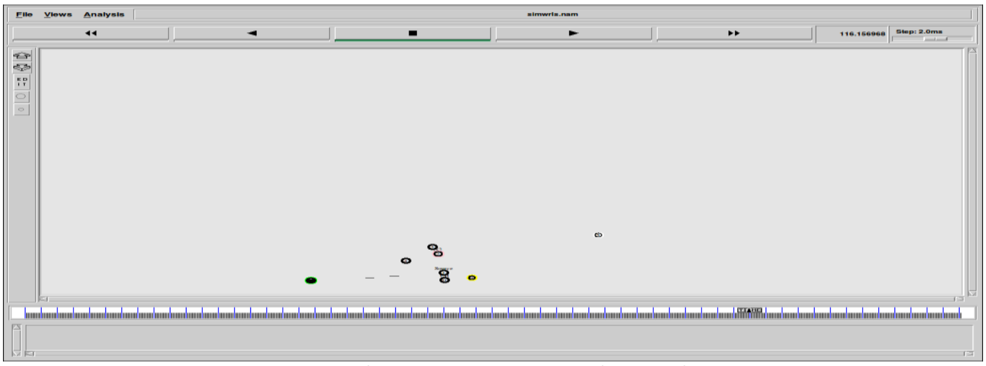
Fig. 9: Data transmission from source to destination after identifying the best route

Different routes may be available, but the source must decide to select the best path for data transmission with low cost and congestion-free. In Figure 9 the best route is identified by the base-station which provides service to the source and destination based on routing tables.

V. CONCLUSION

In this work DYMO-Multipath is presented, a multipath algorithm based on DYMO routing protocol. Simulations show that as the node increases, throughput decreases. The new routing Protocol DYMO-Multipath works well on the average throughput parameter. As the no of nodes increases the performance of DYMO is better than AODV. The second parameter is jitter. As the number of nodes increases, jitter increases. As compared to AODV, DYMO multipath gives less jitter. The last parameter is

Packet delivery ratio. It is analyzed that both the protocols perform same till 30 nodes. From 30 to 60 nodes DYMO shows decreasing performance because of the multipath concept as there are large number of ways in comparison to unicast routing protocol. From 60 to 80 nodes the trend of the protocols is same with AODV performing slightly better. Beyond 80 nodes the performance of DYMO improves significantly. Based on simulation analysis, it is established that DYMO and AODV, DYMO-multipath perform better than AODV exhibit lesser jitter and consequently more throughput and lesser packet loss as we increase the number of nodes. It is also clear that DYMO, though a derivative of AODV is more efficient than the latter since it takes advantage of its salient features carefully pruning its weaknesses. In the future, we intend to examine its performance when RERRs are allowed to be transmitted for unused paths and investigate the effect of invalidation period for alternative paths.

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